TITLE:	HEAT OF DISSOLUTION MEASUREMENTS FOR CO_2 IN MIXED ALKANOLAMINE SOLVENTS
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GRANT NO.:	DE-FG26-03NT41912
PERIOD OF PERFORMANCE:	September, 2003 to March, 2004
DATE:	April 1, 2004

1. ABSTRACT

Program Introduction: Rationale and Objective

The main objective of this project is to measure heat of dissolution of CO_2 in carefully selected mixed alkanolamine solvent systems, and provide such directly measured data that might be used for efficient design of CO_2 capture processes, or for better understanding of thermodynamics of CO_2- alkanolamine systems. Carbon dioxide is one of the major greenhouse gases, and the need for stabilization of its composition in earth's atmosphere is vital for the future of mankind. Although technologies are available for capture and storage of CO_2, these technologies are far too expensive for economical commercialization. Reduction of cost would require research for refinement of the technology. For more economical CO_2 capture and regeneration, there is a need for development of more efficient solvent systems. In this project we will extend the thermodynamic database by measuring heat of solution data of CO_2 in mixed solvents made of MEA (monoethanolamine), MDEA (methyldiethanolamine), piperazine, and water. Mixed solvents of different compositions will be selected and in each case data will be measured at temperatures 40 and 80C and various partial pressures of CO_2. At the end of the project, observations, conclusions, and recommendations will be derived for the choice of mixed solvents for efficient CO_2 capture with potential for commercialization.

Accomplishments Achieved During the Current Period of Performance

During the current period of performance, September 2003 to March 2004, the apparatus for the heat of dissolution measurements has been designed and built. The apparatus consists of a CO_2 gas cylinder, a mass flowmeter, a liquid solvent metering pump, the isothermal micro-calorimeter with the flow cells made by Calorimetry Sciences Corporation (CSC), a back pressure regulator, switch valve for online chromatographic analysis, the GC, and many thermocouples and pressure sensors. The apparatus has been pressure tested for leaks. MEA-CO_2 system has been chosen as the test system. Data for this system will be measured over a range of CO_2 compositions, at a single temperature of 25^oC, and a fixed composition of aqueous solution. The measured data will be compared with the limited data available in the literature for this system. The data measurements have just begun.

Simultaneously, a more thorough literature search was carried out for enthalpy data on CO_2-alkanolamine systems. The available literature data for aqueous CO_2-MEA, CO_2-MDEA, CO_2-DEA, CO_2-MDEA-Sulfolane, and CO_2-MDEA-PZ systems have been extracted and compiled. The variables for data measurements are temperature, CO_2 composition or partial pressure, and the composition of the aqueous mixture. Design of our data measurements should be such that the result will be a complete data set for the CO_2-MEA-MDEA-PZ system. This design will be completed in the next phase of the project.

Plans for the Remaining Period of Performance

The work planned during the next phase of this project is outlined below.

- The test data measurement for the MEA-CO_2 system will be completed
- Data Measurements will be carried out for the MEA-CO_2 system over a wider range of temperatures, CO_2 compositions and compositions of the aqueous mixture.
- Design of experiments for the CO_2-MEA-MDEA-PZ system will be completed.

2. LIST OF PUBLICATIONS AND SUPPORTED STUDENTS

Publications

None

Students Supported Under the Grant

- Sureshkumar Gutti, Ph.D. student in the chemical engineering department , NC A&T State University